

SECTION 34 21 70

TRACTION POWER FACILITIES INSTALLATION REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General requirements
- B. Workmanship
- C. General installation requirements
- D. Conduits and fittings
- E. Concrete structures
- F. Raceway materials and devices
- G. Cables and wires
- H. Identification
- I. Wiring devices
- J. Grounding

1.02 MEASUREMENT AND PAYMENT

Not used

1.03 SUBMITTALS

- A. General: Refer to Section 01 33 00 – Submittal Procedures, and Section 01 33 23 – Shop Drawings, Product Data, and Samples for submittal requirements and procedures.
- B. Submit:
 - 1. Survey verification records for house and equipment pad foundation installation tolerances.
 - 2. Cable pull calculations for cables running between AC and DC houses, and between house and points external to traction power facility sites.

3. Building and equipment anchoring calculations showing anchoring meets Seismic Zone 4 requirements. A California Professional Structural Engineer shall approve calculations.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation requirements for similar work from Division 20 - Facility Services, and Division 26 - Electrical, shall apply; except where superseded or modified by requirements of this Specifications Section.
- B. Installation of equipment and materials in the prefabricated ac and dc equipment houses at the factory and the re-assembly of shipping splits in the field is covered in Section 34 21 05, Prefabricated AC and DC Equipment Houses.
- D. Contractor shall furnish all labor, equipment and materials required to complete the installation of the traction power facilities. The field installation shall provide fully operational traction power facilities.
- E. All electrical work shall be performed in accordance with electrical work stages, phases and step schedule developed by the Contractor and approved by the Engineer.
- F. Technical representative(s) from the traction power equipment supplier's organization shall be made available for supervision during the installation of its equipment.
- G. Installation includes both new facilities and modifications to existing facilities, as indicated.
- H. Furnish and install all raceways and grounding grids on the traction power facility sites, as indicated.
- I. Furnish and install the traction power facilities' civil infrastructure including earthwork, grading, foundations, pavement, landscaping, fencing, perimeter lighting, as indicated. Installation requirements regarding the civil infrastructure shall be as indicated and as specified in the applicable civil works Section of these Specifications.

3.02 WORKMANSHIP

- A. All work shall be performed and completed in a thorough, workmanlike manner, and shall follow the best modern practice in the installation of high-quality equipment and materials, notwithstanding omission of any requirement from these Specifications.

- B. All parts shall be made and installed accurately to American standard gauges for ease of replacement and repairs. All special gauges and templates necessary for field erection shall be furnished by the Contractor and become the property of the Owner at no extra cost.
- C. Installation of traction power equipment, where applicable, shall comply with the National Electrical Installation Standards (NEIS) of the National Electrical Contractors Association (NECA).

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install electrical materials, equipment, and accessories in locations as required, rigid and secure, plumb and level, and in alignment with related and adjoining work.
- B. The Contractor shall verify that foundation grades, embedded leveling channels, and anchor bolt locations are correct and shall perform the following:
 1. All leveling channels in each foundation shall vary from the horizontal by not more than 1/8 inch over the length of the leveling channel. Foundation leveling channels shall vary by not more than 1/8 inch with reference to other leveling channels over the length of the leveling channels.
 2. Level of the top of all foundation concrete shall be a minimum of 1/8 inch below top face of embedded leveling channels.
 3. Top face of house foundation or equipment pad concrete shall vary by not more than 1/8 inch over entire foundation or equipment pad face.
- C. The Contractor shall submit field survey data confirming foundation adherence to required tolerances for each equipment house and equipment pad.
 1. If the survey shows that leveling channels are not level to within required tolerances as specified above, channels shall be made level before setting of the equipment or house. Methods used to level channels shall be approved by the District, and shall meet all seismic requirements suitable for Seismic Zone 4 construction.
 2. If survey shows that the face of the pad or foundation concrete is out of the required tolerance, the high points shall be ground down to within the required tolerance before setting of the equipment or house.
 3. District must approve the survey data and any required remediation prior to delivery and placement of the house or equipment on pads or foundations.
- D. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, angles and anchoring as required to meet the seismic design requirements as specified herein and elsewhere in the Contract Documents. Do not weld electrical materials for attachment or support.
- E. Erection tolerance requirements shall not impair the strength, safety, serviceability, or appearance of the installations.

- F. Install switches, receptacles, special purpose outlets, and cover plates completely and neatly in accordance with California Electrical Code (CEC), and Section 20 70 26 - Common Materials and Methods for Electrical Systems. Plug or cover unused openings in boxes, cabinets, and equipment.
- G. Wherever slots, sleeves, or other openings are provided in floors and walls for the passage of raceways, conduits, and bus ducts, fill such openings in accordance with Section 20 50 13 - Raceways for Facility Services, Article 3.02D.

3.04 CONDUITS AND FITTINGS

- A. Conduits and fittings shall be furnished and installed in accordance with Section 20 50 13 - Raceways for Facility Services as applicable, and as specified herein.
- B. Unless otherwise approved by the Engineer, rigid steel conduits shall be installed whenever raceways are exposed. Electrical metallic tubing (EMT) may be used in low voltage applications allowed by the California Electrical Code (CEC) and approved by the Engineer. Run EMT exposed above 8 feet, or concealed in walls and ceilings.
- C. Temporary heavy duty ultra-violet resistant plastic caps shall be used to prevent debris and other materials from entering and obstructing the conduit during installation. After raceway and cable installation, install permanent cable sealing plugs.
- D. Where waterproofing is required, conduits shall be sealed with watertight duct sealing material, or approved equal.
- E. Metallic conduits entering high resistance grounded equipment shall be insulated from the equipment enclosures.
- F. Damaged conduit surfaces on metal conduit shall be painted with un-thinned zinc-rich paint.
- G. Conduit extensions to existing work shall match existing conduit sizes.
- H. Conduit Ends and Couplings:
 1. Non-metallic type conduit connections shall be of the solvent weld type.
 2. When a standard coupling cannot be used for coupling metal type conduit, an approved threaded union coupling shall be used.
 3. Couplings for metal type conduit shall be tightened to provide a good electrical connection throughout the entire length of the conduit run.
 4. The ends of conduit shall be capped with standard caps or "pennies".
 5. The ends of rigid steel conduit and conduit fittings shall be threaded. When caps or "pennies" are removed, the threaded ends of conduit and conduit fittings shall be provided with conduit bushings.

- I. Conduit markings: Provide approved conduit tags showing conduit identification at ends of all conduits. Tags shall be permanently affixed, and shall identify location of other end of each designated conduit.
- J. Provide separate conduits for power, control, and instrumentation circuits.
- K. Conduit Bends:
 - 1. Unless specified otherwise, conduit bends shall have a radius of not less than six times the inside diameter of the conduit.
 - 2. Where factory bends are not practical, conduit shall be bent in the field by methods and equipment recommended by the conduit manufacturer. Conduits shall not be crimped or flattened.
- L. Surface-Mounted Conduits:
 - 1. Surface mounted conduits shall be run straight, horizontal or vertical on the walls, and parallel to walls, ceilings or other similar surfaces.
 - 2. Route conduit parallel to building lines unless otherwise indicated. Install horizontal raceways close to the ceiling or ceiling beams.
 - 3. Unless otherwise indicated, conduits shall be supported at intervals of not more than 5 feet, and closer where necessary to prevent vibration or unsightly deflection.
 - 4. In dry locations, spring-steel fasteners, clips or clamps specifically designed for supporting exposed single conduits may be used in lieu of conduit straps or hangers.

3.05 CONCRETE STRUCTURES

- A. Pre-cast and cast-in-place structures shall be installed in accordance with Section 20 50 16, Underground Ductwork and Structures for Facilities Services.
- B. Covers of pullboxes and manholes shall be installed flush with the finished grade.

3.06 RACEWAY MATERIALS AND DEVICES

- A. Raceway materials and devices including conduit braces; pull cords; inserts; outlet, junction, and pull boxes; and cable trays shall be installed in accordance with Section 20 50 13, Raceways for Facilities Services.
- B. Conduit bracing shall be installed in accordance with Section 34 21 50, Common Materials and Methods for Traction Power.
- C. After installation of cables in trays, paint or tape the cables with fire-proofing materials.

3.07 CABLES AND WIRES

- A. Cables and wires shall be installed in accordance with Section 20 70 26, Common Materials and Methods for Electrical Systems, Section 26 05 24, Low Voltage Wires and Cables, and Section 34 22 23, Traction Power Cables, as applicable, and as specified herein.
- B. Contractor shall furnish and install all high voltage cables low voltage cables and wiring associated with the traction power facilities, including:
 - 1. 34.5 kV ac cables and associated terminations, hardware and accessories.
 - 2. 5 kV dc cables for the positive and negative feeders, and associated terminations, hardware and accessories.
 - 3. 2 kV dc cables for dc switchgear load measuring circuits
 - 4. Low-voltage cables and wires between ac equipment house, rectifier transformers, dc equipment house and other outdoor equipment within the traction power facility.
 - 5. Fiber-optic and other communication cables and associated termination accessories, for interfacing the traction power facility with the BART communication network; or, with other traction power facilities and devices.
- C. Cables shall be installed in accordance with approved wiring and cable schedules, and per cable manufacturer's instructions. Cables within the traction power facilities shall be continuous without splices.
- D. Install individual conductors and multiple-conductor sheathed cables in equipment conduits, raceways, cable trays, ducts as indicated.
- E. Cables shall be handled in such a manner as to prevent damage to the insulation. The ends of the cable shall be covered to prevent dirt and moisture from entering the cables during handling and installation. The cable shall be kept dry prior to and during installations and shall not be exposed to oil or grease.
- F. Cable Pulling
 - 1. Contractor shall submit cable pulling calculations for cable pulls between equipment houses, between pads, and between traction power facilities and sites external to traction power facilities such as trainways. Calculation shall demonstrate that pull tensions and sidewall pressures are within acceptable tolerances. No cable pulls shall be undertaken prior to acceptance of cable pulling tensions by the District.
 - 2. Cables shall be pulled directly into the conduits from cable reels. The pulling speed shall be limited so that the cables move smoothly into the conduit at a uniform velocity. Steel pulling lines shall not be used in non-metallic conduit. Where pulling grips are used, damaged ends shall be removed as soon as the cables have been installed.

3. Wherever two or more conductors are pulled into one conduit, the cables shall be uncoiled from the two or more reels simultaneously.
4. After installation, all exposed cables and those that are accessible shall be cleaned of dirt, grease, and pulling lubricant, using a commercial cable cleaner approved by the cable manufacturer.

G. Wire terminations:

1. Connectors and terminals shall have temperature ratings equal to or greater than those for the wiring and shall be in accordance with UL 486A.
2. Connections shall be made only at the terminals on the devices, on terminal blocks, or on the buses:
 - a. No splices or taps shall be made between these terminal points.
 - b. No more than two wires shall be connected to any terminal point.
 - c. Connections shall be made by ring- or spring-type lugs with insulated compression sleeves. The insulated sleeve shall firmly grip the wire insulation, and the metallic portion shall firmly grip the strands of the conductor. The crimping tool and lugs shall be of a system design in which the crimping tool will not release until the crimp has been completed.
3. Low voltage circuits requiring external connections and all unused terminals on auxiliary contacts, devices, relays, and control switches shall be brought to accessible terminal blocks.

H. Installation of fiber optic cables and terminations shall be in accordance with Section 20 70 23, Electronic Circuits, Wires and Cables.

3.08 IDENTIFICATION

- A. Conduits shall be identified by means of metal tags affixed to the conduit at the exterior side of all exposed pull and junction boxes, stub-ups, switchgear, panels and other electrical devices, and shall be located inside of all buried or concealed boxes. Tags shall be permanent, made of stainless steel, machine-embossed and held in place with two stainless steel wires.
- B. Provide heat-shrinkable, pre-printed flame resistant plastic sleeves designed for fastening to cables in vaults, pull boxes, manholes, and at all terminations of cable or wire.
- C. The pre-printed wiring sleeves shall contain wire number and the location of the other end.

3.09 WIRING DEVICES

- A. Wiring devices shall be installed in accordance with Section 20 70 26, Common Materials and Methods for Electrical Systems.

3.10 GROUNDING

- A. Grounding system shall be installed and tested in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems, and as indicated.
- B. Welding molds, fillers, charges, and sleeves shall be suitable for the conductor types and sizes.
- C. Ground Connections:
 - 1. Except for high-resistance grounded equipment, all other electrical equipment enclosures, support structures, metallic raceways, metallic conduits, under floor ducts, cable trays, boxes, cabinets, exposed expansion joints, lighting fixtures and receptacles shall be grounded as required by CEC, and as indicated. Equipment grounding conductors shall be connected to the ground test stations, and shall be insulated from high-resistance grounded equipment.
 - 2. Connect all ground test stations to the ground grid.

END OF SECTION 34 21 70